

WHAT IS CLAIMED IS:

- 1 1. A method of performing finite element analysis on a shell including:
 - 2 (a) modeling the geometry of the shell using subdivision surfaces;
 - 3 (b) characterizing an environment for the shell, including environmental factors
4 affecting the mechanical behavior of the modeled shell;
 - 5 (c) computing the mechanical response of the modeled shell, taking into account the
6 characterized environment, using a finite element analysis; and
 - 7 (d) outputting a description of the geometry of the modeled shell as determined from
8 the computed mechanical response.
- 1 2. The method of claim 1, wherein the environment factors includes loading conditions,
2 material properties, and boundary conditions for the modeled shell.
- 1 3. The method of claim 2, wherein the loading conditions includes an indication of applied
2 forces.
- 1 4. The method of claim 2, wherein the loading conditions includes an indication of thermal
2 loading.
- 1 5. The method of claim 1, further including outputting indications of the characterized
2 environment.
- 1 6. The method of claim 1, wherein the finite element analysis uses subdivision basis
2 functions as shape functions.
- 1 7. The method of claim 1, wherein the finite element analysis uses suitably smooth shape
2 functions.

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1 9. A system for performing finite element analysis on a shell including:

- 2 (a) means for modeling the geometry of the shell using subdivision surfaces;
- 3 (b) means for characterizing an environment for the shell, including environmental
- 4 factors affecting the mechanical behavior of the modeled shell;
- 5 (c) means for computing the mechanical response of the modeled shell, taking into
- 6 account the characterized environment, using a finite element analysis; and
- 7 (d) means for outputting a description of the geometry of the modeled shell as
- 8 determined from the computed mechanical response.

1 10. The system of claim 9, wherein the environment factors includes loading conditions,

2 material properties, and boundary conditions for the modeled shell.

1 11. The system of claim 10, wherein the loading conditions includes an indication of applied

2 forces.

1 12. The system of claim 10, wherein the loading conditions includes an indication of thermal

2 loading.

1 13. The system of claim 9, further including means for outputting indications of the

2 characterized environment.

1 14. The system of claim 9, wherein the finite element analysis uses subdivision basis

2 functions as shape functions.

1 15. The system of claim 9, wherein the finite element analysis uses suitably smooth shape

2 functions.

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- (a) means for inputting a mesh comprising a set of data points each having connectivity to neighboring data points, the mesh defining physical parameters;
- (b) means for specifying an initial state for the mesh;
- (c) means for defining a set of linear differential equations comprising a stiffness matrix and an external forcing vector, at least one such equation having a fourth order differential operator;
- (d) means for solving the set of linear equations as applied to the mesh;
- (e) means for outputting the solution to the set of linear equations as defining a modification of the initial state of the mesh based on the stiffness matrix and in response to the external forcing vector.

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1 17. A computer program, residing on a computer-readable medium, for performing finite
2 element analysis on a shell, the computer program comprising instructions for causing a
3 computer to:

- 4 (a) model the geometry of the shell using subdivision surfaces;
5 (b) characterize an environment for the shell, including environmental factors affecting
6 the mechanical behavior of the modeled shell;
7 (c) compute the mechanical response of the modeled shell, taking into account the
8 characterized environment, using a finite element analysis; and
9 (d) output a description of the geometry of the modeled shell as determined from the
10 computed mechanical response.

1 18. The computer program of claim 17, wherein the environment factors includes loading
2 conditions, material properties, and boundary conditions for the modeled shell.

1 19. The computer program of claim 18, wherein the loading conditions includes an indication
2 of applied forces.

1 20. The computer program of claim 18, wherein the loading conditions includes an indication
2 of thermal loading.

1 21. The computer program of claim 17, further including instructions for causing the
2 computer to output indications of the characterized environment.

1 22. The computer program of claim 17, wherein the finite element analysis uses subdivision
2 basis functions as shape functions.

1 23. The computer program of claim 17, wherein the finite element analysis uses suitably
2 smooth shape functions.

- 1 24. A computer program, residing on a computer-readable medium, for performing finite
2 element analysis using subdivision basis functions, the computer program comprising
3 instructions for causing a computer to:
- 4 (a) input a mesh comprising a set of data points each having connectivity to
5 neighboring data points, the mesh defining physical parameters;
 - 6 (b) specify an initial state for the mesh;
 - 7 (c) define a set of linear differential equations comprising a stiffness matrix and an
8 external forcing vector, at least one such equation having a fourth order differential
9 operator;
 - 10 (d) solve the set of linear equations as applied to the mesh;
 - 11 (e) output the solution to the set of linear equations as defining a modification of the
12 initial state of the mesh based on the stiffness matrix and in response to the external
13 forcing vector.

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